

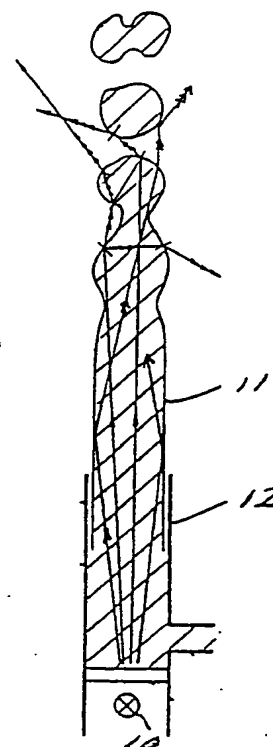
**PCT**WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau

## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification<sup>4</sup> :</b> <b>F21P 7/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> WO 85/ 05167 <b>(43) International Publication Date:</b> 21 November 1985 (21.11.85)
<b>(21) International Application Number:</b> PCT/EP85/00202 <b>(22) International Filing Date:</b> 6 May 1985 (06.05.85) <b>(31) Priority Application Numbers:</b> 8401479 PG 9786 <b>(32) Priority Dates:</b> 9 May 1984 (09.05.84) 18 March 1985 (18.03.85) <b>(33) Priority Countries:</b> NL AU  <b>(71)(72) Applicants and Inventors:</b> KESSENER, Herman, Paulus, Maria [NL/NL]; Van Slichtenhorststraat 13, NL-6524 JH Nijmegen (NL). BRULS, Georgius, Josephus, Cyrillus, Ludovicus [NL/NL]; Van Somerenstraat 26, NL-6521 BS Nijmegen (NL).		<b>(81) Designated States:</b> AT (European patent), BE (European patent), CH (European patent), DE (European patent), FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.  <b>Published</b> <i>With international search report.</i>

**(54) Title:** LIQUID OUTLET ADAPTED TO PROVIDE LIGHTING EFFECTS AND/OR FOR ILLUMINATION**(57) Abstract**

Liquid outlets, as may be used in the fields of 1) domestic plumbing ware as water taps, faucets, drinking fountains, 2) ornamental and display fountains, 3) beverage dispensers, 4) liquid outlets as used in laboratory or industrial processes. Light of arbitrary wavelength(s) is introduced into a jet or stream of liquid, either hollow, solid or subdivided, such that this light is totally or partially conducted by said jet or stream. In contrast with prior art, known in the field of ornamental fountains, a light source organ is placed inside the liquid-stream close to the outlet, such that the light source organ is in heat exchange relationship with the liquid flowing through the outlet and the light output into the liquid stream is maximized, or at a distance from the outlet but optically coupled to that outlet along any curved or bent pathway by means of some auxiliary light guiding mechanism. The invention also relates to the shape of the light source organ and/or light guide in view of the hydrodynamical properties of the liquid stream, the introduction of gas bubbles, particles or dyes into the liquid-stream, the use of a switching device in relation to the presence of a flow of liquid and the use of color filters and optical prisms.



***FOR THE PURPOSES OF INFORMATION ONLY***

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GA	Gabon	MR	Mauritania
AU	Australia	GB	United Kingdom	MW	Malawi
BB	Barbados	HU	Hungary	NL	Netherlands
BE	Belgium	IT	Italy	NO	Norway
BG	Bulgaria	JP	Japan	RO	Romania
BR	Brazil	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	LI	Liechtenstein	SN	Senegal
CH	Switzerland	LK	Sri Lanka	SU	Soviet Union
CM	Cameroon	LU	Luxembourg	TD	Chad
DE	Germany, Federal Republic of	MC	Monaco	TG	Togo
DK	Denmark	MG	Madagascar	US	United States of America
FI	Finland	ML	Mali		
FR	France				


LIQUID OUTLET ADAPTED TO PROVIDE LIGHTING EFFECTS  
AND/OR FOR ILLUMINATION

THIS INVENTION relates to liquid outlets. The liquid outlets with which the invention may be associated (but is not to be limited to) may include fountain nozzles, water faucets including domestic water faucets, hose nozzles and the like.

It is an object of this invention to provide liquid outlets whereby the fluid stream provides a source of illumination.

In relation to water fountains it is known to illuminate such water fountains whereby the illumination is by means of reflection from light sources which are generally hidden from view and are directed onto the water jets. While such illumination effects can be quite effective the available light is not used effectively since the visual effect results from that light which is reflected from the water jets to the eye and much of the light is either transmitted past the jets or through the jets. In addition since the light sources must be located around or closely adjacent to the water jets it is often the case that from particular positions around the fountain an observer is dazzled by the lights which impairs the view of the fountain.

Several alternatives to the conventional fountain have been proposed in the past whereby the water is caused to pass into a chamber from which it passes directly into the fountain stream and light is projected from the exterior of the chamber towards the outlet. Examples of such prior art is disclosed in U.S. Patent Specification 1839994 and French Patent Specification 1.187.689. In each of these instances however the light source is located outside the fluid stream and light is shone into a housing through which the fluid flows on its way to the outlet. These arrangements are clumsy and bulky and there is consider-



able light loss due to transmission losses between the light entering the chamber and transmission of the light through the chamber to the outlet due to dispersion, reflection and refraction.

It is an object of this invention to provide a liquid outlet whereby light can be introduced into a fluid stream at the outlet, in order that maximum light input is effected with a minimum of losses.

In one form the invention resides in a liquid outlet comprising a housing connected to a source of liquid having an outlet capable of producing a substantially non-turbulent and/or low turbulent stream of liquid at said outlet for a distance beyond said outlet and a light source to introduce light into the stream at the outlet.

In one preferred form of the above invention the light source comprises a lamp located within said housing and supported in a holder which is in heat exchange relationship with the liquid flowing through the housing.

According to a preferred feature of the invention the light source is optically coupled to the outlet.

According to a preferred feature of the above feature the lamp is located adjacent the outlet.

According to a further preferred feature of the invention the light source is located remote from the outlet and a light guide provides the optical coupling between the light source and outlet.

It is the aspect of the invention to eliminate some of the disadvantages referred above in relation to fountains in that it provides for means whereby the fluid stream of the

fountain serves as a light guide to deliver light to the portion of the stream at which the stream becomes significantly turbulent or disperses and whereby light is transmitted to the observer by multiple and variable refractions at the liquid/air and/or air/liquid boundary surfaces.

In addition the invention provides a means whereby a surface may be illuminated by having a liquid stream directed at a surface whereby the light is reflected by the surface at the point of impact of the liquid stream.

The invention will be more fully understood in the light of the following description of several specific embodiments. The description is made with reference to the accompanying drawings of which:

Figs. 1, 2 and 3 illustrate the optics associated with the invention;

Fig. 4 illustrates a domestic faucet incorporating the first embodiment;

Fig. 5 illustrates a domestic faucet incorporating the second embodiment;

Fig. 6 illustrates the third embodiment of the invention;

Fig. 7 illustrates a fourth embodiment of the invention;

Fig. 8 illustrates a fifth embodiment of the invention;

Figs. 9a and 9b are a sectional plan view and an elevation of a sixth embodiment of the invention;

Fig. 10 illustrates a liquid faucet incorporating the seventh embodiment of the invention;

Figs. 11a and 11b illustrate a faucet having two forms of the eighth embodiment of the invention;

Figs. 12a and 12b illustrate a faucet having two forms of the ninth embodiment of the invention;

Figs. 12c, 12d and 12e illustrate another liquid outlet according to the ninth embodiment of the invention;

Fig. 13 is a sectional elevation of a fountain nozzle according to the tenth embodiment of the invention;

Fig. 14 is a sectional elevation of another form of fountain nozzle incorporating the eleventh embodiment of the invention;

Fig. 15 is an elevation of another form of fountain nozzle incorporating the twelfth embodiment of the invention;

Figs. 16 and 16a are sectional elevations of fountains comprising a descending stream of water incorporating the thirteenth embodiment of the invention;

Fig. 17 is a view of the fourteenth embodiment of the invention; and

Figs. 18 and 18a are a view of the fifteenth embodiment of the invention.

The principle on which the invention of each of the embodiments thereof relies relates to the total internal reflection of light on its passage from a medium of high refractive index to a medium of lower refractive index at the boundary between the two media provided the angle of incidence is greater than or equal to the critical angle for such media. Even where the angle of incidence is less than the critical angle there will also be a degree of reflection of the light back into the media rather than passage beyond the boundary. Each of these phenomena are illustrated at Figs. 2a and 2b. Where the light is projected from a light source into a stream of water 11 issuing from a nozzle 12 predominantly most of the light will be totally internally reflected within the column until such time as turbulence is introduced into the column at which time the light will be caused to pass from the column causing the turbulent portion of the column to emit light. As shown at Fig. 1 as a result of the column

of water or jet of water functions as a light guide provided the boundary conditions between water and air are such as to allow total internal reflection light being transmitted through the column. In addition the jet of water itself may become visible due to the presence of foreign particles in the water, bubbles or the like as is pointed out by arrow A in Fig. 3.

As shown at Fig. 3 where a substantially non-turbulent stream of liquid 11 issues from a nozzle 12 and strikes a surface 13 the area of impact of the jet will be illuminated producing a spectacular display.

It is the spectacular nature of the visual effects produced by the light within the column of water and its eventual escape therefrom that is the object of each of the embodiments described below.

The first embodiment shown at Fig. 4 comprises a water faucet 11 controlled by a tap 14 and having an extended water delivery nozzle 15 with an outlet 16. The interior of the nozzle 15 accommodates a lamp housing 17 adjacent the outlet 16 which supports a halogen-quartz lamp 18, the transparent outer end 19 of the lamp housing 17 adjacent the outlet 16 is formed hydro-dynamically to avoid the creation of turbulence associated with cavitation (which will cause light from lamp 18 to be dispersed, whence less light will reach outlet 16) in the fluid flow passing through the nozzle 15 to the outlet 16 past the lamp housing 17. In addition the formation of the outer end of the lamp housing to avoid such turbulence creates a condenser lens 19 which serves to focus the light issuing from the lamp housing. Moreover, lamp housing 17 and fluid stream will be in heat-exchange relationship, whereby sufficient cooling of the lamp housing is guaranteed.

The lamp housing 17 may be fitted with reflective surfaces on the inside, in order to maximise light output towards fluid outlet 16. The nozzle 15 is formed with a channel 20 which extends substantially the full length of the nozzle and opens at a position which would be normally out of view to allow for the accommodation of electrical cables for the lamp 18. The portion of the channel 20 adjacent the lamp housing 17 is increased in its lateral dimension and is associated with a closure 21 to provide access to the rear of the lamp housing for replacement of the lamp 18. The activation of the lamp 18 is effected by a control which is sensitive to the operation of the tap 14 to effect flow of water through the nozzle 15 or alternatively a flow sensitive member located in the water stream.

When the jet, leaving such fluid outlet, has an irregular surface, light will emerge from the jet along its length at those points where internal reflection is not total. Hereby the fluid stream (water stream) achieves an increased visibility, which, apart from esthetic effects, can be of advantage in situations where illumination is poor or when an increased visibility of the fluid jet is desired. Whenever the jet has a very smooth boundary surface, conditions for total internal reflection are met all along the fluid stream, hereby the presence of light will not become apparent and the jet will have a normal clear aspect, until after the stream has been rendered turbulent or strikes a surface.

Also, when the continuity of such smooth, normal looking but light-conducting jet, is disrupted over a very short distance, for instance by rapidly moving an object (e.g. a piece of wire) through the jet at right angles to the jet, light will emanate from the jet at this discontinuity, which discontinuity will then become visible and appear as a blob of light. As the discontinuity moves



along the jet at the speed of the liquid in the jet, this blot of light will appear to be moving along the jet, thus providing a spectacular effect.

Means may be provided to disrupt the continuity of such light-conducting jets according to certain time-patterns.

When a smooth, normal looking, but light-conducting, jet is directed downward, the diameter of the jet will decrease as function of its length, as the velocity of the liquid in the jet will increase due to gravity, thus concentration of the light contained in the jet occurring, until cohesive forces of the molecules of the liquid will cause the jet to break up into drops. In this region of the jet, all light, now concentrated in the thin jet just before it breaks up, will leave the jet and radiate intensely to the surroundings, providing for a very bright effect.

However, any particle of foreign matter, either colored, fluorescent, or having any other properties, or air or gas bubble, contained in the fluid flowing from the nozzle 15 will scatter light that is within the jet, which light may hit the surface of the jet at angles smaller than the critical angle, and thus become visible.

In both cases above, i.e. the irregular, bright-looking jet, and the smooth, normal looking jet, light is present within the jet. As a result when filling a receptacle with such fluid jet, light will spread inside the receptacle, thereby illuminating the receptacle from the inside which in general facilitates inspection, while a spectacular effect is provided when a transparent receptacle such as a glass is being filled from the nozzle.

The second embodiment of Fig. 5 also relates to a water faucet 11 operated by a valve 14 having a nozzle 15 formed with an outlet 16. An intermediate chamber 22 is located between the outlet of the tap 14 and the lower end of the nozzle 15 and accommodates a lamp housing 17 having a window directed towards the lower end of the nozzle 15. The lamp housing 17 accommodates a halogen lamp 18 which housing 17 is in heat exchange relationship with the fluid in the intermediate chamber 22, and which directs light into the lower end of the nozzle 15, the interior surface of which is formed to be smooth and made reflective by a reflective coating 23a. As with the first embodiment the operation of the lamp 18 is effected through a switch associated with the tap 14, a pressure-or flow-sensitive switch or an electronic switching device in the water stream. Due to the reflective nature of the interior of the nozzle and the substantially parallel configuration of the side walls the nozzle 15 serves as a light guide which provides optical coupling between a lamp 18 and the outlet 16.

The third embodiment of Fig. 6 relates to a faucet similar to the form of the second embodiment of Fig. 5 except that the interior of the nozzle 15 is formed for a significant portion of the distance between the chamber 22 and the outlet 16 by a tubular liner 23 which is formed of a transparent material such as perspex. The exterior face of the liner is spaced from the internal wall of the housing to form an air gap 23b therebetween and suitable sealing means 24 is provided at either end of the liner to prevent the entry of fluid into that space. The light from the lamp 18 is optically coupled with the outlet 16 by the light guide which is formed by the tubular liner and the water being conducted therethrough. The light on

its passage through the nozzle 15 is partially reflected by the internal surface of the tubular liner 23, and partially refracted into the wall of the tubular liner 23, which portion of light will undergo total internal reflection at the external surface of the tubular liner when the angle of incidence onto that surface is greater than the critical angle. Light reflected from that surface will strike again the internal surface of the tubular liner, and be refracted as well as reflected, or undergo total internal reflection.

Thus, the tubular liner serves as a hollow light guide, whereby light is conducted in the wall of the tubular liner as well as in the fluid conducted herethrough.

The tubular liner 23 may be coated with a transparent material having an index of refraction lower than the material of the tubular liner 23, thus providing for a hollow light guide, that does not depend on the presence of the air gap 23b.

Moreover, when the interior wall of nozzle 15 between chamber 22 and outlet 16 is covered with a transparent material having an index of refraction smaller than the index of refraction of the fluid it conducts, light will undergo total internal reflection at this surface whenever the angle of incidence is greater than the critical angle involved, thus, light from lightsource 18 will be conducted through the fluid to outlet 16.

An alternative form of the embodiment comprises exposing the tubular liner such that at least the free end portion of the liner is exposed. As a result when water is flowing from the nozzle the ends of the nozzle glow and may project some light onto the exterior of the jet of water.

The fourth embodiment of Fig. 7 also comprises a modification of the second embodiment of Fig. 5 whereby the light guide is a conventional flexible light guide consisting of glass fibres, synthetic fibres, or being fluid filled, is accommodated within a conduit (channel) 26 inside of the nozzle 15.

The channel 26 may be closed sealingly to prevent entry of water into it.

If the conventional light guide is resistant to the influence of water, the channel 26 may be superfluous. The outer end of the channel 26 supports a closure which is hydro-dynamically shaped to prevent the production of turbulence and associated cavitation within the jet stream flowing from the outlet 16 and to provide a condensing effect for the light emanating from the light guide 25.

The fifth embodiment of Fig. 8 is also a variation of the second embodiment of Fig. 5 whereby the light guide comprises a clear transparent rod 25 supported within the nozzle by spacer elements 27 at spaced intervals along its length and which extends between the lamp 18 (not shown) and the outlet nozzle 16. Here, the guiding of light is based on the difference of index of refraction between the material of the rod and the surrounding fluid, e.g. in case of perspex and water being 1.49 and 1.33 respectively.

The sixth embodiment as shown at Figs. 9a and 9b relates to a nozzle 28 having an outlet 29, that is directed more or less at right angles in respect to the longitudinal axis of the nozzle, located more or less remote from the taps. The nozzle 28 supports a lamp housing 30 adjacent the outlet 29 and accommodates a lamp 31. The housing 30 is formed with a window directed at the outlet 29 while

the remaining interior face of the housing 30 is rendered reflective to direct any light incident thereon to the window and thus to the jet stream 29. The operation of the lamp 31 is effected by operation of the taps associated with the nozzle 28 or a flow control switch, pressure sensitive switch or electronic switching device sensitive to the flow, pressure or presence of water through the nozzle or conduits connected thereto. The electrical cables for the lamp 31 are accommodated within a channel 32 located within the nozzle 28 while the wall of the channel opposite the lamp housing 30 is provided with a closure which facilitates access to the lamp for the replacement thereof.

The seventh embodiment of Fig. 10 is a modification of the sixth embodiment of Fig. 9 whereby the lamp 31 is accommodated within a hydro-dynamically shaped housing 30 supported in spaced relation within the nozzle 28. The lamp is located closely adjacent a concave mirror 34 whereby light from the lamp which is incident on the mirror 34 is directed to the outlet 29. The electrical cable connected to the lamp 31 is accommodated within a flexible conduit extending through the nozzle 28, passing out of the nozzle at some suitable location out of view, and opening up to atmosphere. Due to the flexible nature of the conduit 35 and the direct relation with atmosphere, any pressure variations produced within the housing 31 and the conduit 35 by the presence or absence of fluid flow through the nozzle 28 and the heat produced by the light source may be readily accommodated.

The eighth embodiment of Figs. 11a and 11b is a further modification of the sixth embodiment of Fig. 9. The first form shown at Fig. 11a utilises a rod shaped clear transparent light guide 36, supported within the nozzle 20 by spacer elements (not shown), and is formed at its outer

end with an oblique reflective face which reflects any light reaching the end of the light guide 36 towards the nozzle outlet 29. The form shown at 11b accommodates a conventional flexible light guide 36 within a sealed channel 38. A plane or concave mirror is located adjacent to the free end of the light guide 36 to direct any light emanating from the light guide to the nozzle outlet 29.

Again, the channel 38 is superfluous if the flexible light guide is resistant to the influence of the fluid.

The ninth embodiment of Figs. 12a and 12b comprise two forms which utilise the fluid being conducted by the nozzle 28 as the light conducting medium. In the case of the first form shown at Fig. 12a the interior of the nozzle 28 supports a tubular liner formed of a clear transparent material such as perspex the external walls of which are spaced from the internal walls of the nozzle 28 and either end of the space so created is sealed to prevent the entry of any water. As in the case of the third embodiment of Fig. 6 light from a remotely located lamp (not shown) is conducted to the outer end of the nozzle by the water flowing through the nozzle and the walls of the tubular element. The outer end of the nozzle 28 supports a concave mirror which directs any light incident thereon which has passed through the nozzle 28 to the outlet 29. In the case of the second form of the embodiment the internal walls of the nozzle 28 are rendered smooth and reflective.

It should be appreciated that the nozzle outlets described untill now can take any form or shape, circular, oval, rectangular, elongated, etc. . Thus, a particular embodiment, as shown in fig. 12 c and 12d, may have an elongated, slit-like outlet to produce a sheet of water, e.g. to be used as a waterfaucet controlled by taps remote from the outlet, or a fountain display.

Here again, the lamp housing 101 is in heat exchange relationship with the liquid, and light emanating from light source 107 is directed via window 102 into the fluid, entering the faucet via inlet 100 into intermediate chamber 105, towards outlet 103, in a direct manner and/or indirectly via the internal wall of the nozzle which is rendered reflective, into the fluid stream 104.

The window 102 may be hydrodynamically shaped to avoid creation of turbulence and associated cavitation. However, when the dimensions of the intermediate chamber 105 are large compared to the dimensions of the outlet 103, the velocity of the liquid in the intermediate chamber will be small, and the window does not necessarily have to be hydrodynamically shaped.

Thus, the window 102 can be made hollow, as in fig. 12e, such that a light condensing effect is created by the liquid in the hollow 106 of window 102, while sufficient cooling is still guaranteed, and concentration of light directed towards the nozzle outlet is maximised.

Alternatively, one or more prisms or optical grids may be positioned between light source and outlet at or near window 102, such that the sheet of water, being expelled from such elongated nozzle outlet, contains light of different colors at different positions along the length of the outlet, in the same order as occurs in a rainbow, as is pointed out by the characters R (red), Y (yellow), V (violet) in fig. 12c.

Such watertap or faucet, or fountain, may be called appropriately a "rainbow" - tap, -faucet, or -fountain:

Naturally, color filters may be placed between the light source and the outlet in order to create any combination of colors of the light conducted in the jet.

The tenth embodiment of Fig. 13 is directed towards a fountain nozzle 41 having a chamber 42 located in the conduit immediately prior to the outlet 43 which supports a lamp housing 44 accommodating a lamp 45. The lamp housing 44 is hydro-dynamically shaped to avoid the creation of any turbulence in the fluid stream leaving the

outlet and as a result the window of the lamp housing 44 created by such shaping serves as a condenser lens. The internal face of the chamber 42 beyond the lamp housing 44 is rendered reflective<sup>(e.g.)</sup> by a coating 46 to ensure that any light incident thereon is directed to the outlet 43.

The eleventh embodiment of Fig. 14 is a variation of the tenth embodiment of Fig. 13 whereby the chamber 42 is eliminated by providing a lamp housing 44 of reduced dimensions, such that the nozzle may have a reduced cross-sectional diameter (20 mm or less), enabling long slender nozzles of any bend or curved form producing light conducting fluid jets, without any sign proving the presence of a light source being visible from the outside.

The tenth and eleventh embodiments of Figs. 13 and 14 the electric cables for the lamp 45 are accommodated within a flexible conduit 47 extending through the water conduits providing the water supply for the fountain and exiting therefrom at some suitable location. The flexible nature of the conduit which opens to atmosphere at its outer end ensures that any pressure variations induced within the lamp housing 44 and the conduit 47 are accommodated.

The twelfth embodiment of Fig. 15 relates to a fountain nozzle 41 in which a flow deflector 48 is located at the outlet 43 to provide a bell shaped fan 49. A lamp housing 44 accommodating a lamp (not shown) is located directly below the deflector and the interior walls of the nozzle and flow deflector of the region above the lamp housing 44 are reflective by a coating 46 and as a result the water departing the nozzle 41 serves as a light guide until the fan begins to break up at which point the light within the water becomes visible to produce a spectacular display.



The thirteenth embodiment of Fig. 16 relates to a fountain of the waterfall type whereby a sheet of descending water 50 is created by a dam 51 located to one side of a water reservoir 52. The dam is formed with apertures 53 on its inner face which permit the entry of the water into the interior of the dam and an outlet 54 at the upper end of its exterior face such that water flowing from within the dam merges with water flowing over the exterior surface of the dam to produce a non-turbulent stream of descending water 50. A lamp housing 55 is located adjacent the outlet 54 and is adapted to direct light emanating from the lamp at the outlet 54. Due to the non-turbulent nature of the descending sheet of water for at least a significant portion of travel below the dam 50 the light is entrapped in that sheet of water and is released when the flow is rendered turbulent or strikes a surface to produce a spectacular display.

Alternatively, as shown in fig. 16b, a sheet of descending water is created by a dam 151, and a lightsource in a housing 155 directs light from under the surface of the water in reservoir 152 towards the surface of the water near the brim of dam 151, preferably at an angle greater than the critical angle, which light will then undergo total internal reflection at that surface. Thus, a substantial part of that light will be entrapped in the descending sheet, providing for a spectacular display.

The fourteenth embodiment of Fig. 17 relates to the incorporation of a lamp housing 60 within a hose nozzle 61 the interior walls of which beyond the lamp housing 60 may be rendered reflective. The electrical cables for the lamp within the lamp housing 60 are accommodated within a flexible conduit 62 which extends through the hose 63 connected to the nozzle 61 to exit from the water conduit to which the hose is connected at some suitable location. As a result of the embodiment a hose nozzle is produced which may be used to produce a spectacular display and/or to illuminate those items at which the water stream is being directed.

It should be appreciated that in the case of the embodiments of Figs. 13, 14, 15, 16 and 17 the lamp housing may be replaced by a light guide extending from a remotely located lamp housing to the outlet whereby the lamp housing may be accommodated within the fluid stream at the remote location or separate from the fluid stream. The light guides described in relation to the embodiments of Figs. 5 to 12 may be used in the embodiments of Figs. 13 to 17.

In addition, in relation to each of the embodiments means may be provided for introducing a controlled stream of air or gas bubbles, or any particles as dye particles, fluorescent or not, or with other characteristics into the stream of water. As a result, the bubbles or particles would be illuminated within the jet stream to provide a spectacular display.

In addition the jet streams produced at the outlet of the embodiments may take any configuration.

Also, when a jet or stream of light-conducting liquid collides with a secondary jet or stream, which may or may not be light-conducting, turbulence at the site of impact of the jets may disturb the light-conducting properties of the primary jet, such that light may leave the primary jet, providing for a spectacular display. This effect is particularly suitable in case of a light-conducting sheet of water that is hit by one or more secondary jets.

Fig. 18 illustrates another embodiment of the invention relating to a set of fountain nozzles 73 in which the lamp housing 71 is accommodated within an intermediate chamber 72, thus surrounded by and in heat exchange relationship with the water that flows to the nozzles 73. The water outlets 73 comprises a set of nozzles spaced around the circumference of a circle or is circular or part circular

in configuration. The window 74 for the lamp housing is located in the central area defined by the outlet whereby the light therefrom is directed into the space surrounded by the jet stream from the nozzle and into the jet streams to be conducted thereby.

Moreover, in case of a number of more or less parallel arranged nozzles, light from said lightsource will also be directed to waterdrops falling from the top of the jets that are expelled from the nozzles 73. These drops, by their unstable and changing configurations, may act as small mirrors by means of total internal reflection in the drops, such that an observer sees the lightsource (normally hidden from his view) via such moving drop over a certain distance, due to the fact that the drop is somewhere between lightsource and observer. The drops may well appear as sparks falling from the jets.

Alternatively, as is shown in fig. 19a, the end of the nozzles 73 may be flattened in a manner that sheets 75 of water are expelled from the nozzles with the longitudinal axis of such sheets more or less tangent to the line along which the nozzles are arranged, such that these sheets will merge to form a hollow jet of water 76. Such hollow jet of water will not need a slot along its longitudinal axis, as in U.S. Patent Specification 3.866.832, in order to prevent collapse of the hollow jet, as the hollow of the watercolumn created by such merging jets is exposed to atmosphere via the spaces 77 between the separate nozzles 73.

Thus, a hollow column of water 76 is created, which will conduct light emanating from lightsource 78, which lightsource is positioned in a housing 79 which is in heat-exchange relationship with the water passing through the housing 80 to the nozzles 73.

It should be appreciated that the scope of the invention need not be limited to the particular scope of the embodiments described above. For instance, the invention, as realised in a particular embodiment, may be used in beverage dispensers and cooling processes, where clear fluids are or can be used (e.g. a lathe, in cutting, grinding, polishing - processes), and light may be projected along with the cooling fluid to facilitate inspection. In addition, light of any wave length or color may be used in each of the embodiments discussed.

THE CLAIMS defining the invention are as follows:-

1. A liquid outlet comprising a housing connected to a pressurised source of liquid having an outlet capable of producing a substantially non-turbulent and/or low turbulent stream of liquid with light conducting properties at said outlet and for a distance beyond said outlet, characterised by a light source organ located at the outlet or optically coupled to the outlet such that the light is introduced into the stream to be conducted thereby.
2. A liquid outlet as claimed at claim 1 having the characteristic that the light source organ is located within said housing and is in heat exchange relationship with liquid passing through the housing.
3. A liquid outlet as claimed at claim 2 having the characteristic that the light source organ is located adjacent the outlet.
4. A liquid outlet as claimed at claim 1 or 2 having the characteristic that the light source organ is located remote from the outlet and a light guide provides the optical coupling between the light source organ and the outlet.
5. A liquid outlet as claimed at claim 4 having the characteristic that the light guide is flexible and comprises a glass fibre light guide, synthetic fibre light guide or a fluid filled light guide.
6. A liquid outlet as claimed at claim 4 having the characteristic that the light guide comprises a length of transparent rod shaped material having a refractive index greater than the refractive index of the liquid and having a free end located adjacent said outlet.

7. A liquid outlet as claimed at claim 4 having the characteristic that the light guide is accommodated within a channel extending through the housing which is sealed from the entry of the liquid.

8. A liquid outlet as claimed at claim 4 having the characteristic that the light guide comprises the inner walls of the housing which are substantially smooth and reflective.

9. A liquid outlet as claimed at claim 4 having the characteristic that the walls of the housing are covered with a transparent material having an index of refraction smaller than the index of refraction of the fluid conducted through the housing to the outlet.

10. A liquid outlet as claimed at claim 8 having the characteristic that the walls of at least a portion of the housing in the region of the outlet are transparent.

11. A liquid outlet as claimed at claim 4 having the characteristic that the light guide comprises a tube extending through the housing which conducts the liquid for at least a portion of its travels through the housing, the external face of the tube being spaced from the internal walls of the housing and the gap therebetween containing a transparent medium having a refractive index less than that of the tube, the tube being formed of a transparent material having a refractive index greater or less than the refractive index of the liquid.

12. A liquid outlet as claimed at claim 3 having the characteristic that the light source organ comprises a lamp accommodated within a holder, the face of which holder directed at the outlet is formed with a window having the optical effect of a converging lens.

13. A liquid outlet as claimed at claim 12 having the characteristic that the holder is hydrodynamically shaped to minimize any turbulence which may be created hereby.

14. A liquid outlet as claimed at claim 3, 4 or 12 having the characteristic that a reflective surface is interposed between the light source holder and the outlet to reflect light from the lamp to the outlet.

15. A liquid outlet as claimed at claim 5, 6 or 7 having the characteristic that the end of the light guide is hydro-dynamically shaped and serves as a convergent lens.

16. A liquid outlet as claimed at claim 13 having the characteristic that the interior of the light source organ is connected to the atmosphere through a tube therebetween which also may support electrical cables for said light source organ.

17. A liquid outlet as claimed at any one of the preceding claims having the characteristic that the liquid outlet comprises a fountain nozzle.

18. A liquid outlet as claimed at any one of claims 1 to 16 having the characteristic that the liquid outlet comprises a water faucet.

19. A liquid outlet as claimed at any one of claims 1 to 18 having the characteristic that the liquid outlet comprises a nozzle mounted to the end of a flexible tube or hose.

20. A liquid outlet as claimed at claim 17 having the characteristic that the outlet has mounted therein a flow detector whereby a fan shaped stream issues from said outlet.

21. A liquid outlet as claimed at claims 1 to 16 having the characteristic that said housing comprises a dam through and/or over which liquid must flow to the outlet to fall from the outlet.
22. A liquid outlet as claimed at any one of claims 1 to 21 having the characteristic that the outlet produces a stream having an elongated cross-section.
23. A liquid outlet as claimed at claims 1 to 19 having the characteristic that the outlet comprises a set of nozzles arranged along the circumference of a circle or any closed line.
24. A liquid outlet as claimed at claim 23 having the characteristic that the end of said nozzles is flattened in such way that the resulting jets merge to substantiate a hollow column of liquid.
25. A liquid outlet as claimed at any one of the preceding claims having the characteristic that gas bubbles are introduced into the stream.
26. A liquid outlet as claimed at claims 1 to 24 having the characteristic that particles of any kind or color are introduced into the stream.
27. A liquid outlet as claimed at any one of the preceding claims having the characteristic that the light from said light source is coloured.
28. A liquid outlet as claimed at any one of the preceding claims having the characteristic that one or more prisms or optical grids are placed between the light source organ and the outlet.
29. A liquid outlet as claimed at any one of the preceding claims having the characteristic that one or more colorfilters are placed between the light source organ and the outlet.

30. A liquid outlet as claimed at any one of the preceding claims having the characteristic that the liquid is water.

31. A liquid outlet as claimed at any one of the preceding claims having the characteristic that the outlet comprises a watertap or faucet.

32. A liquid outlet as claimed at any one of the claims 1 to 30 having the characteristic that the outlet comprises a fountain.

33. A liquid outlet as claimed at any one of claims 1 to 29 having the characteristic that the liquid is a beverage.

34. A liquid outlet as claimed at any one of claims 1 to 29 having the characteristic that the liquid is a cooling liquid.

35. A liquid outlet as claimed at any one of the preceding claims having the characteristic that the light source organ is activated by a switch sensitive to the flow of liquid through or to the housing.

36. A liquid outlet substantially as herein described with reference to the accompanying drawings.



1/16

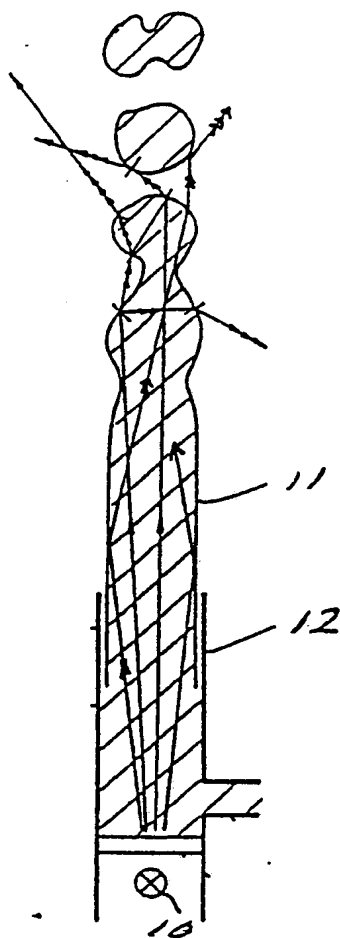


FIG. 1.

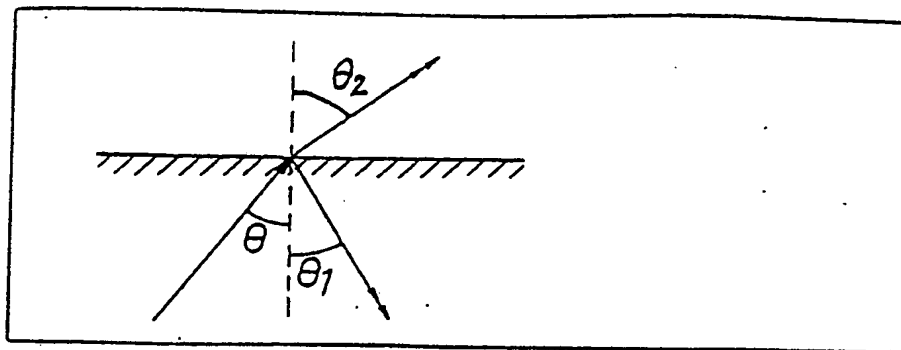


FIG. 2a

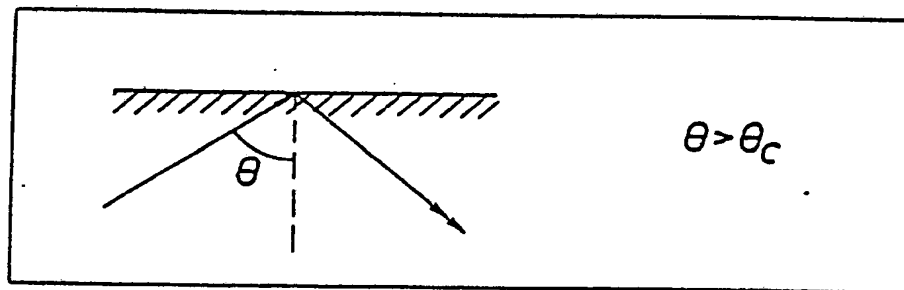


FIG. 2b

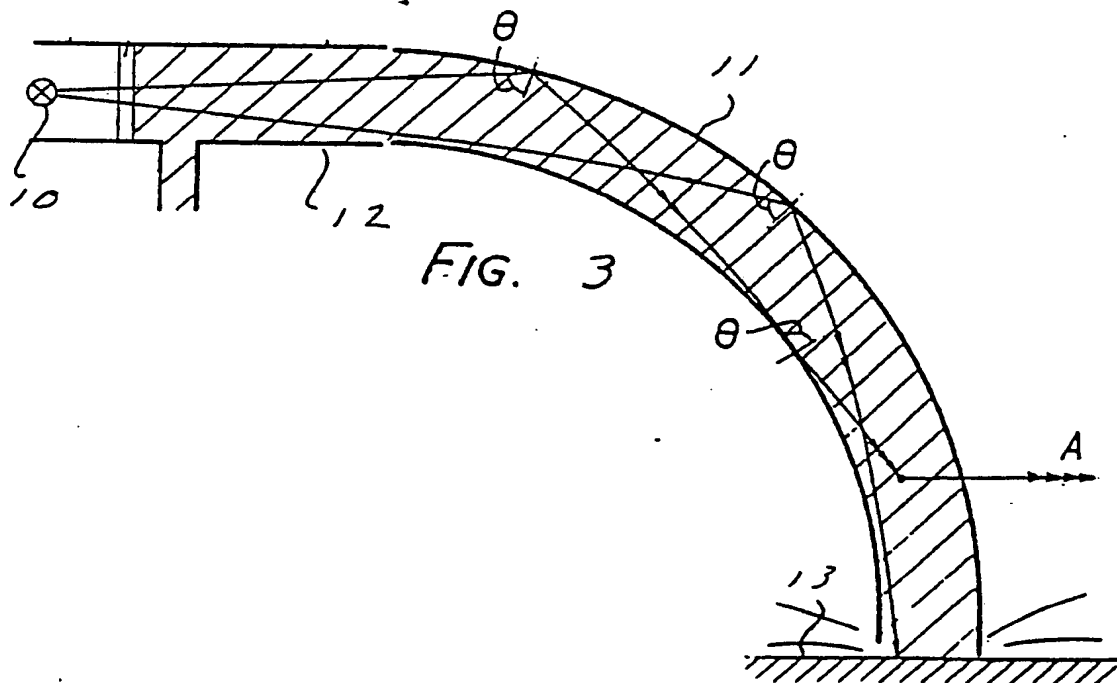


FIG. 3

3 / 16

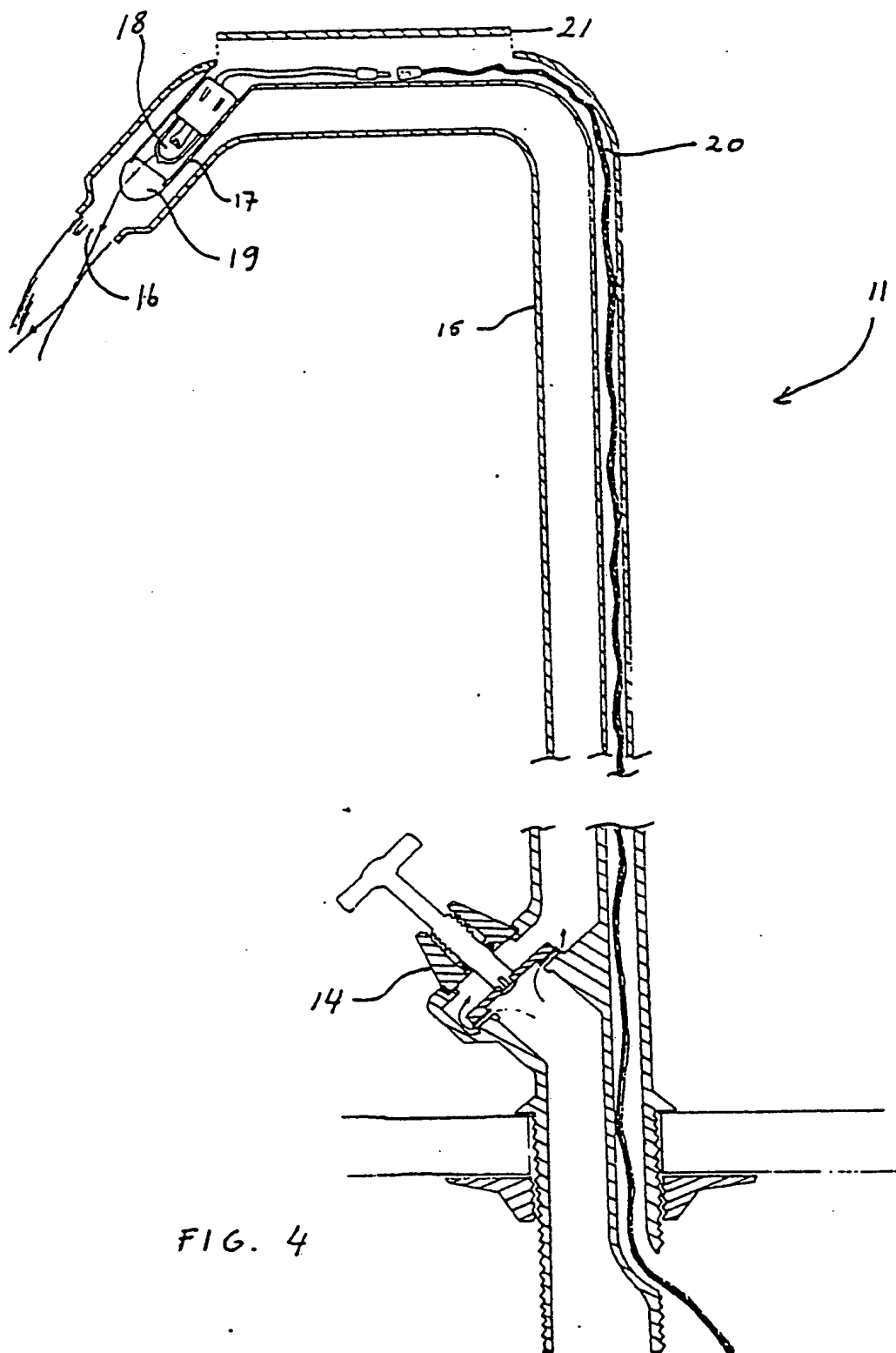
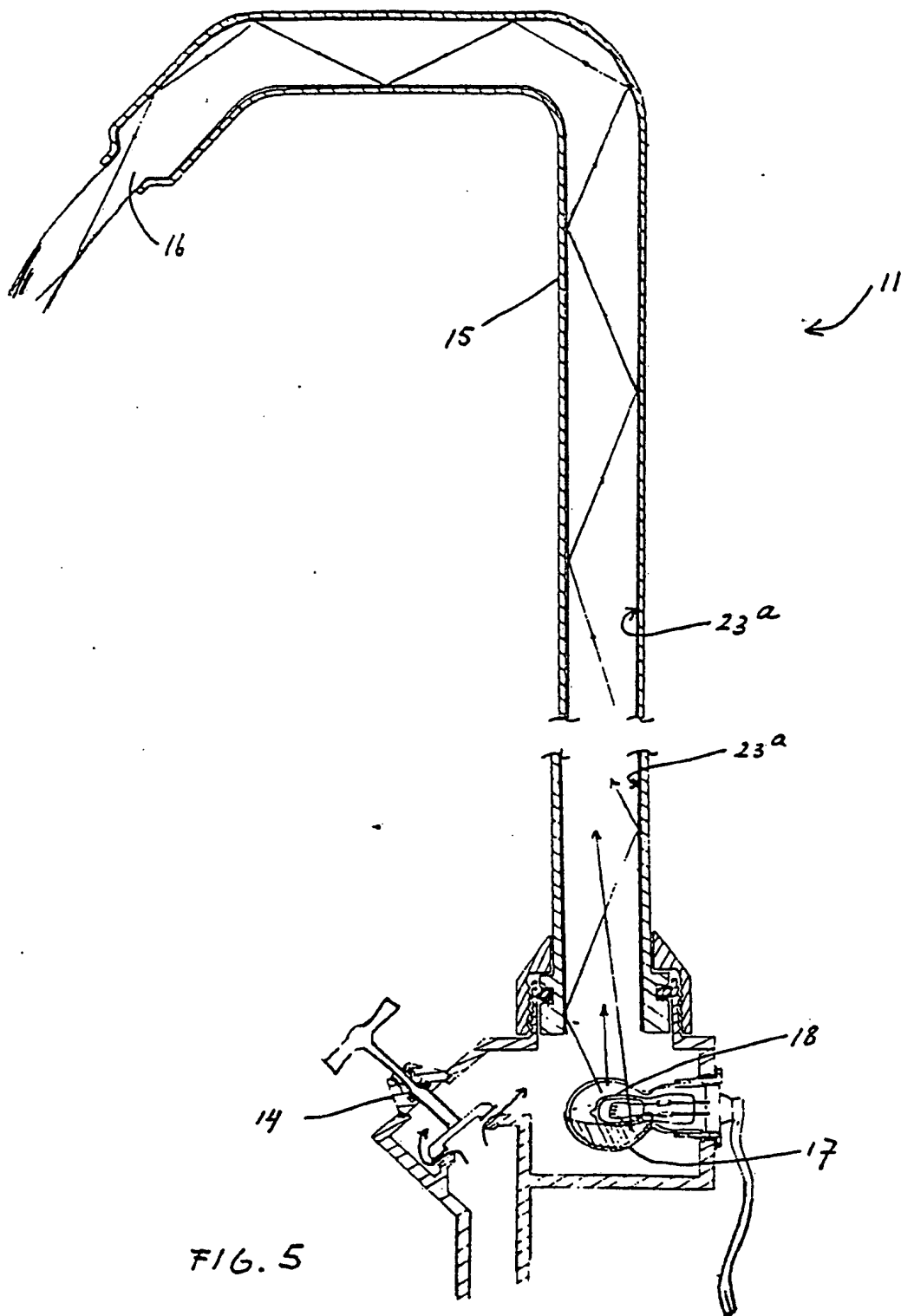


FIG. 4

4 / 16



5/16

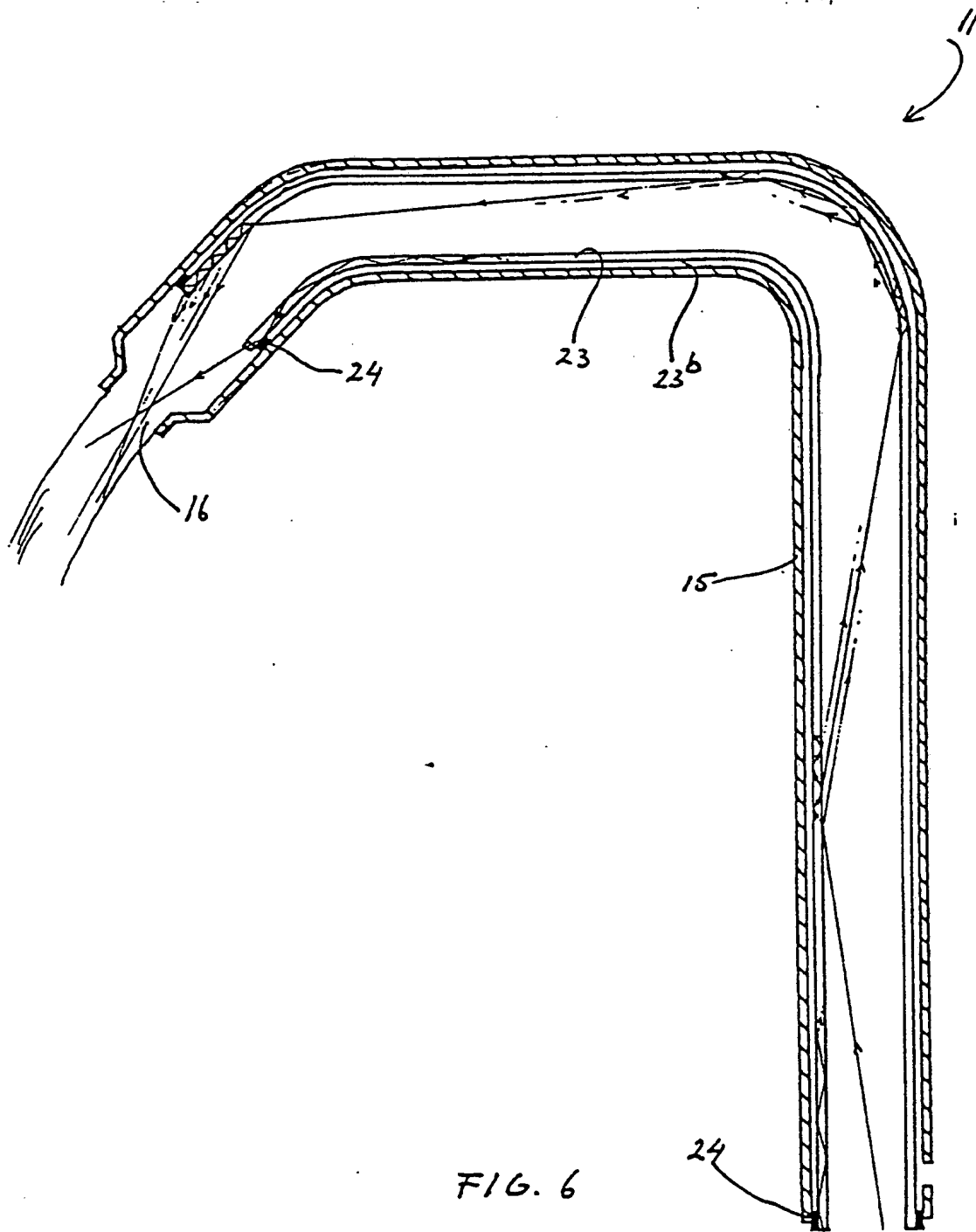


FIG. 6

6 / 16

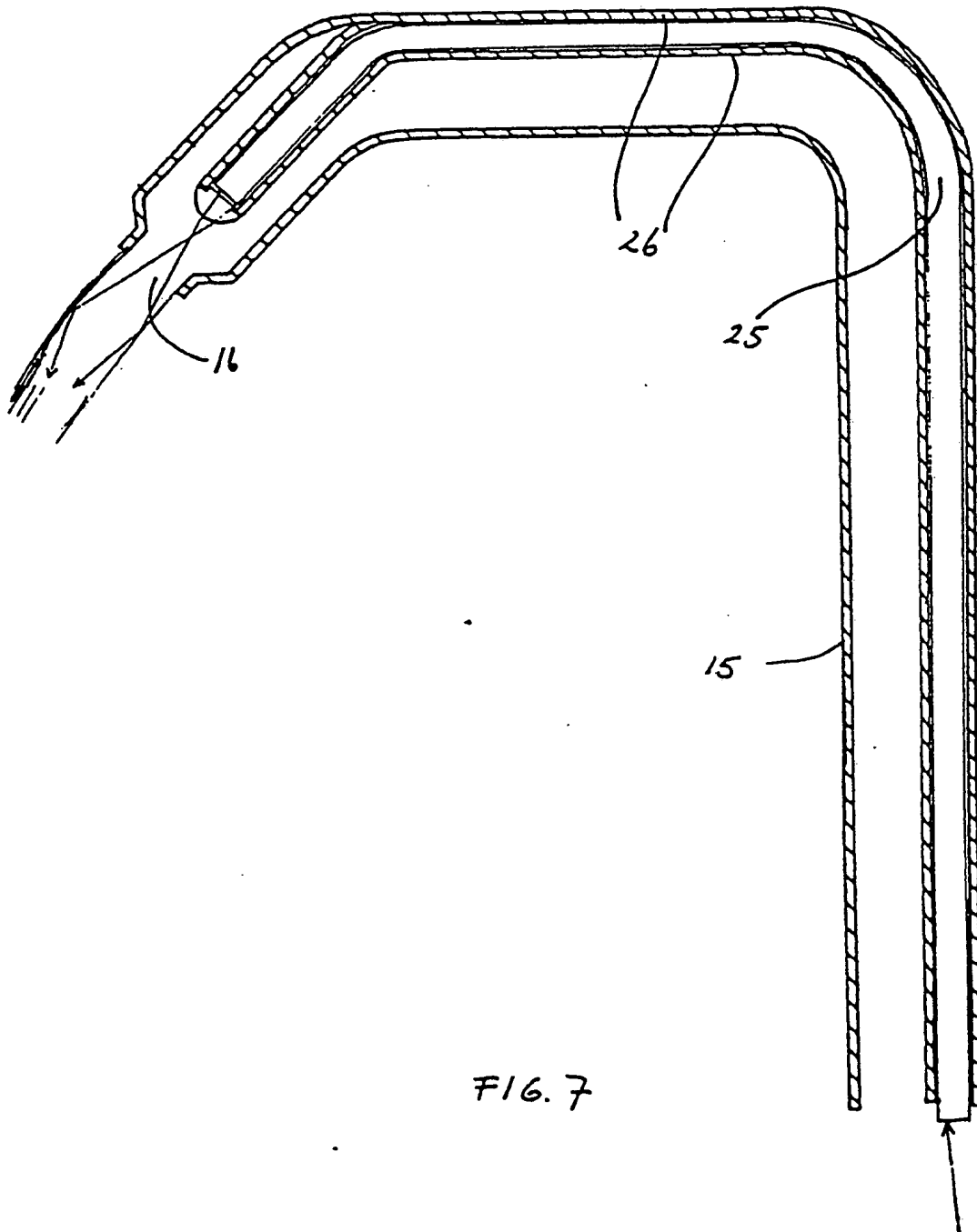


FIG. 7

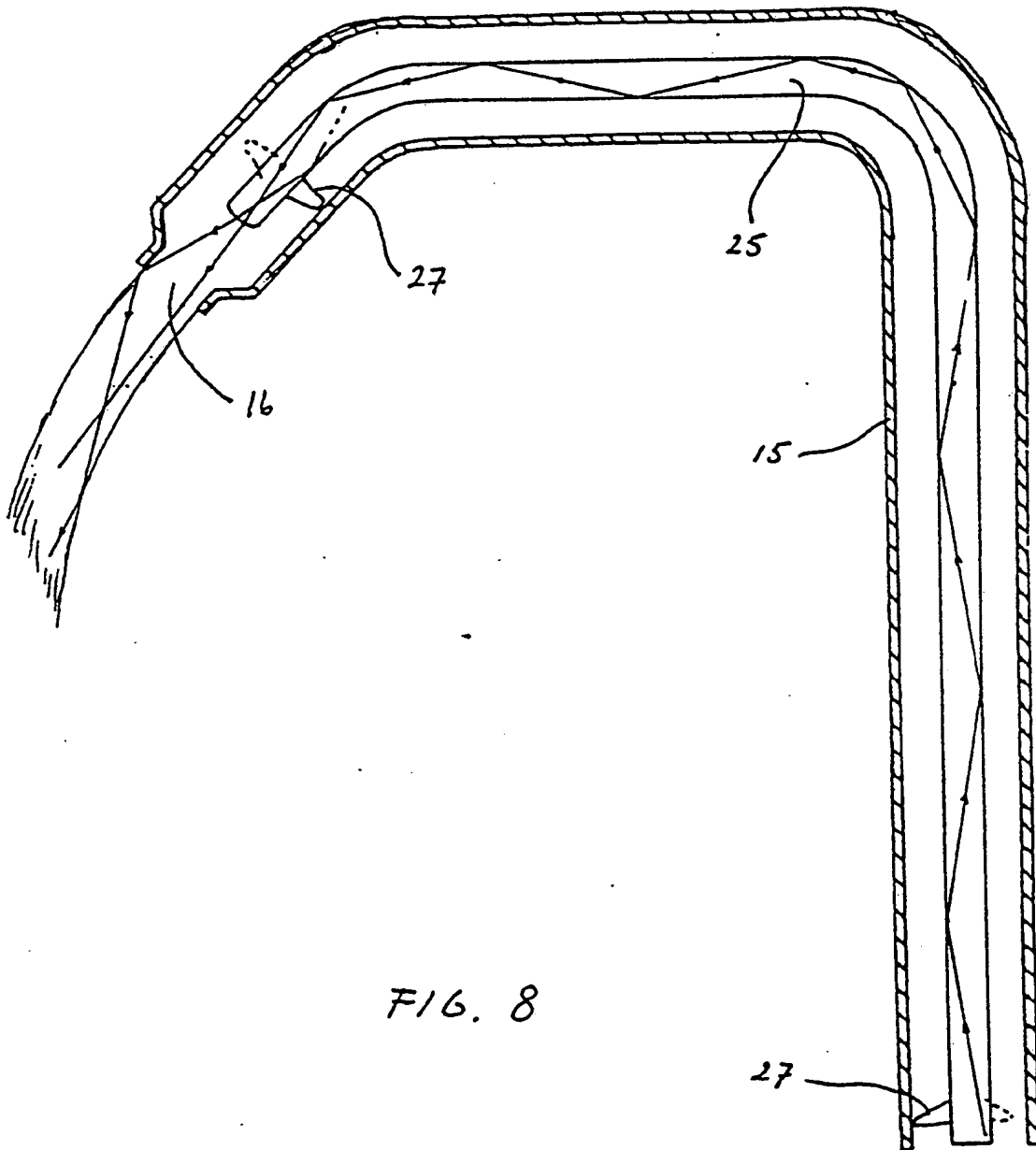
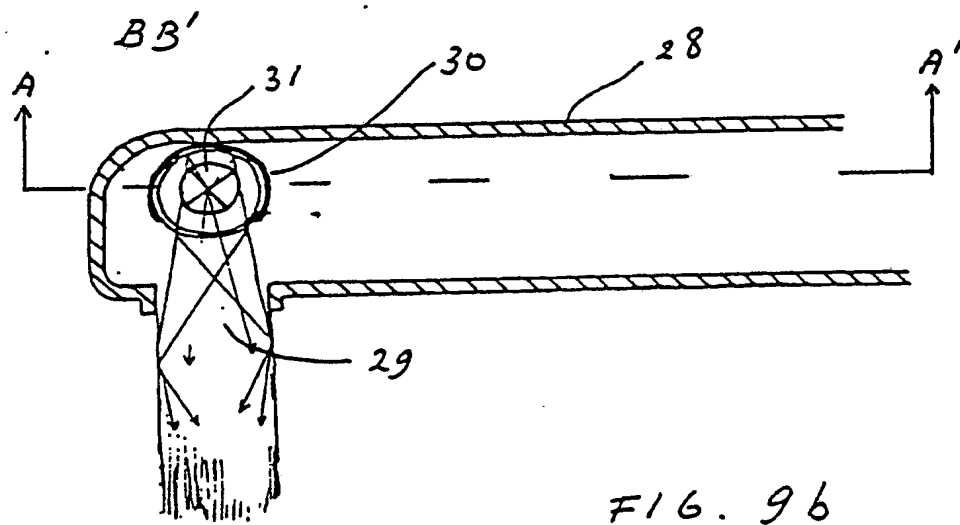
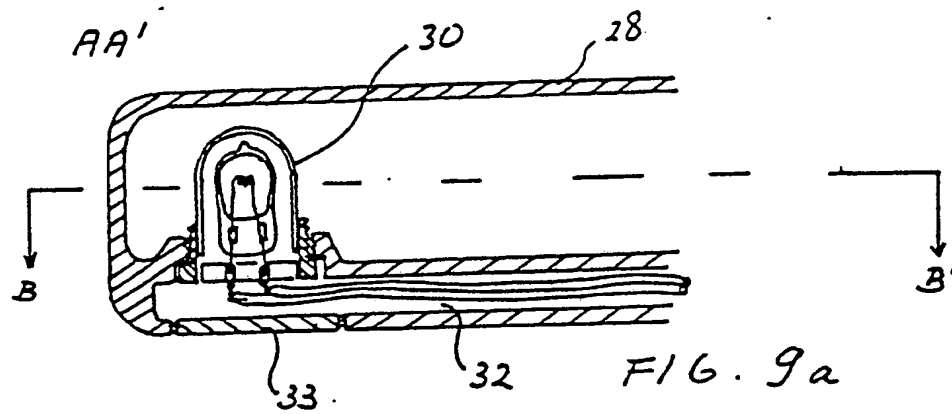
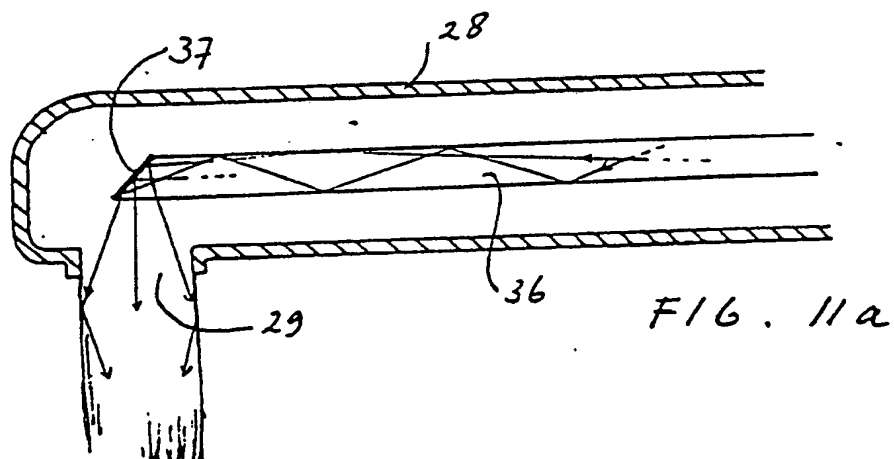
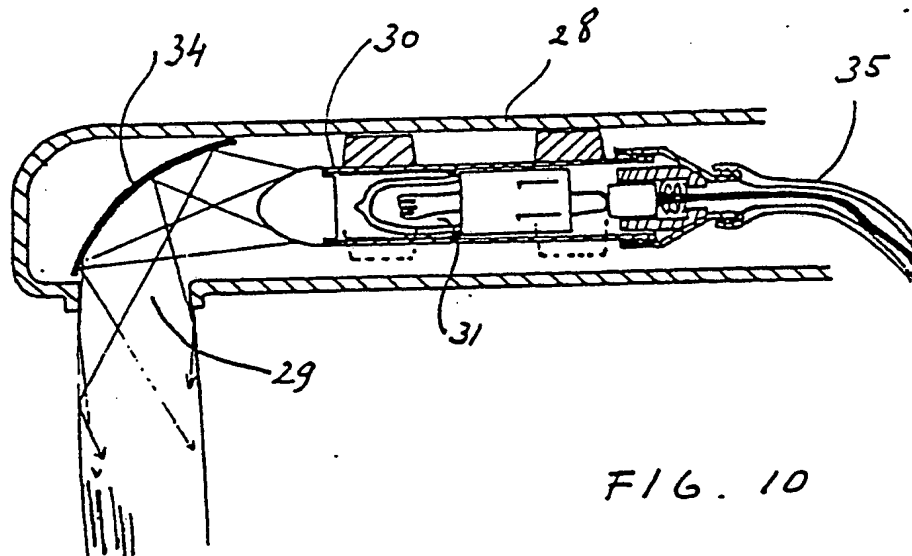


FIG. 8





9/16



10/16

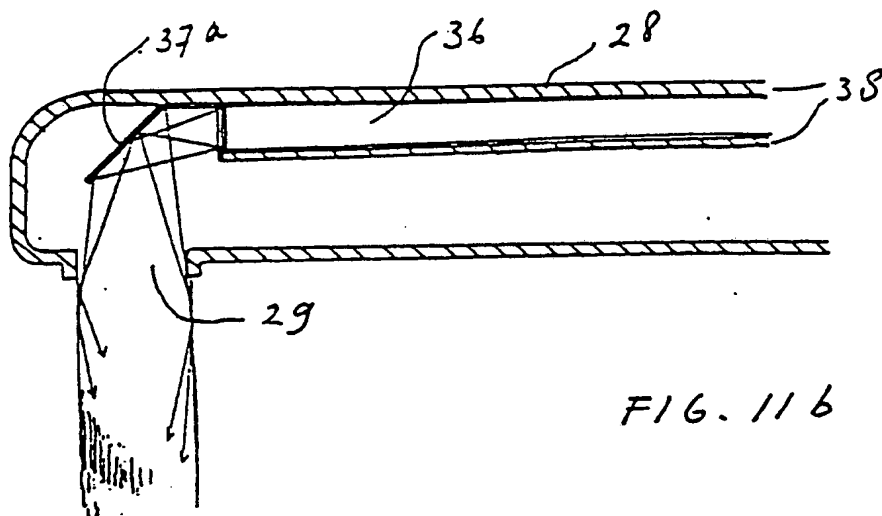


FIG. 11b

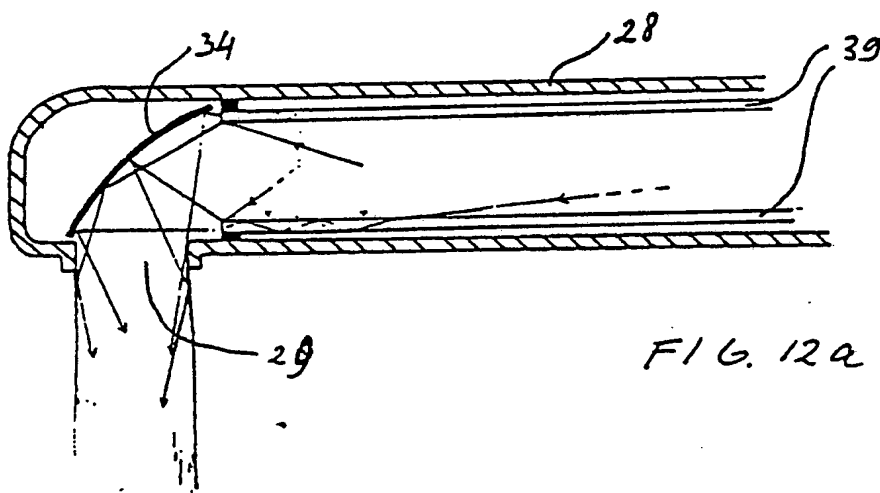


FIG. 12a

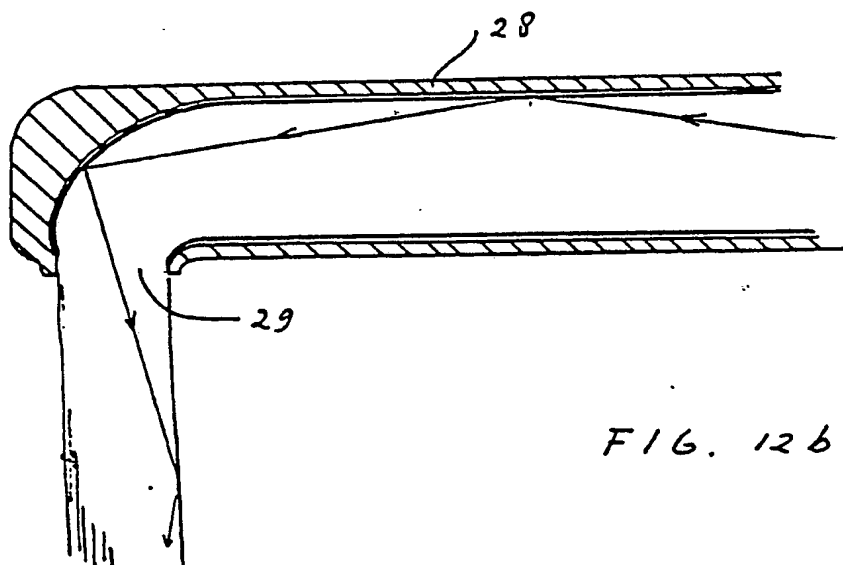
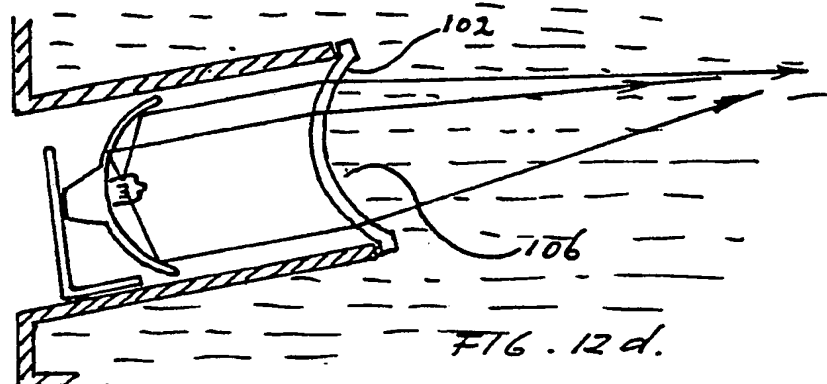
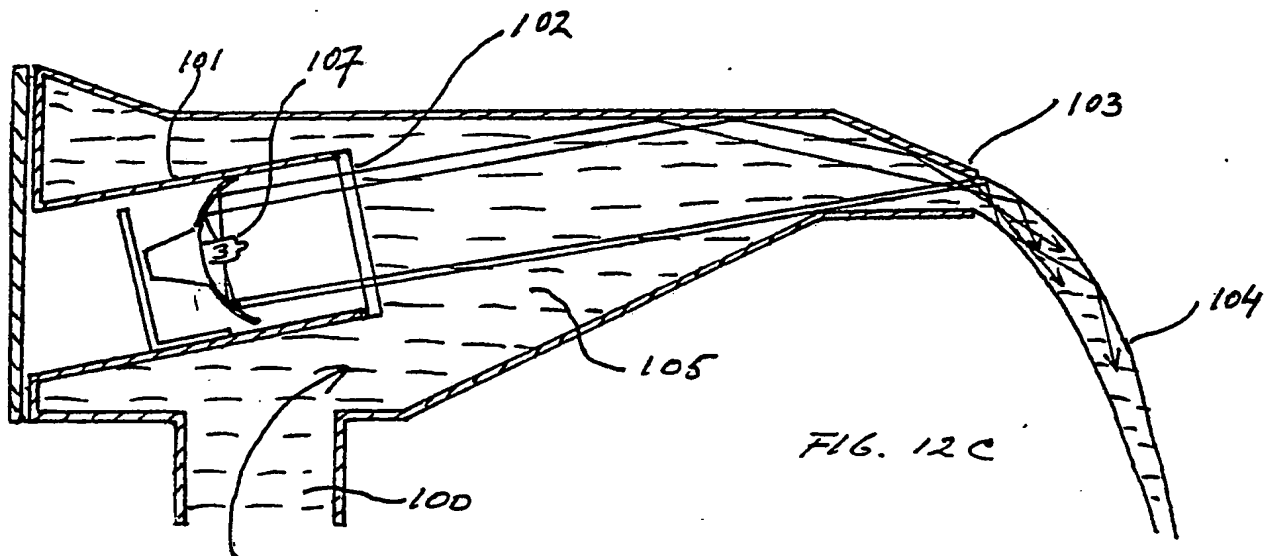
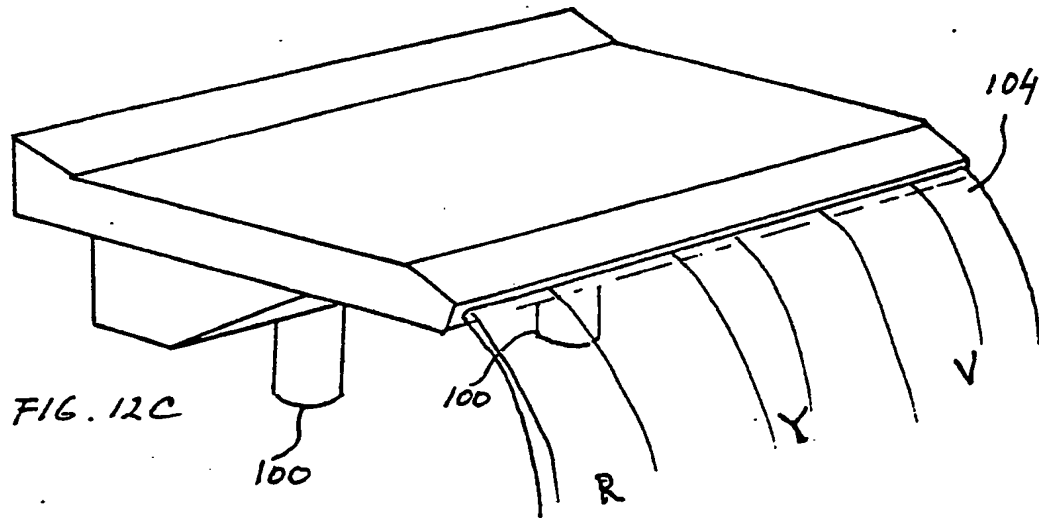
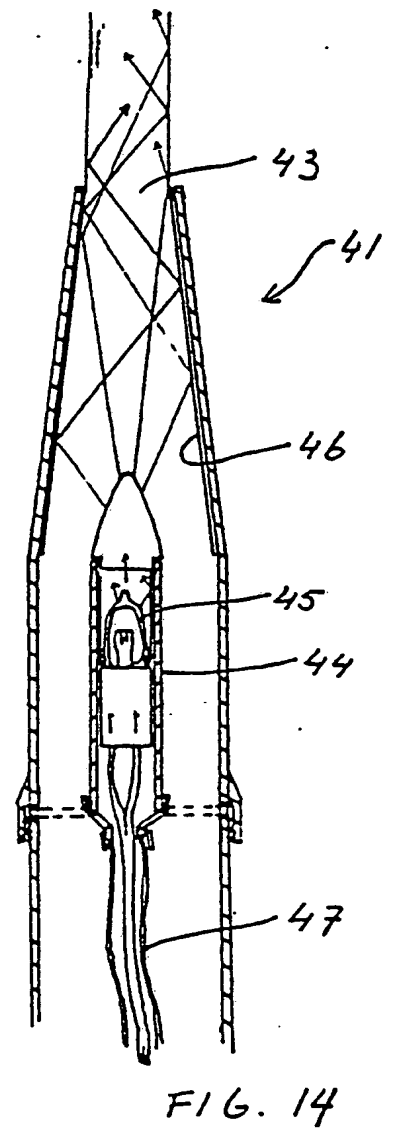
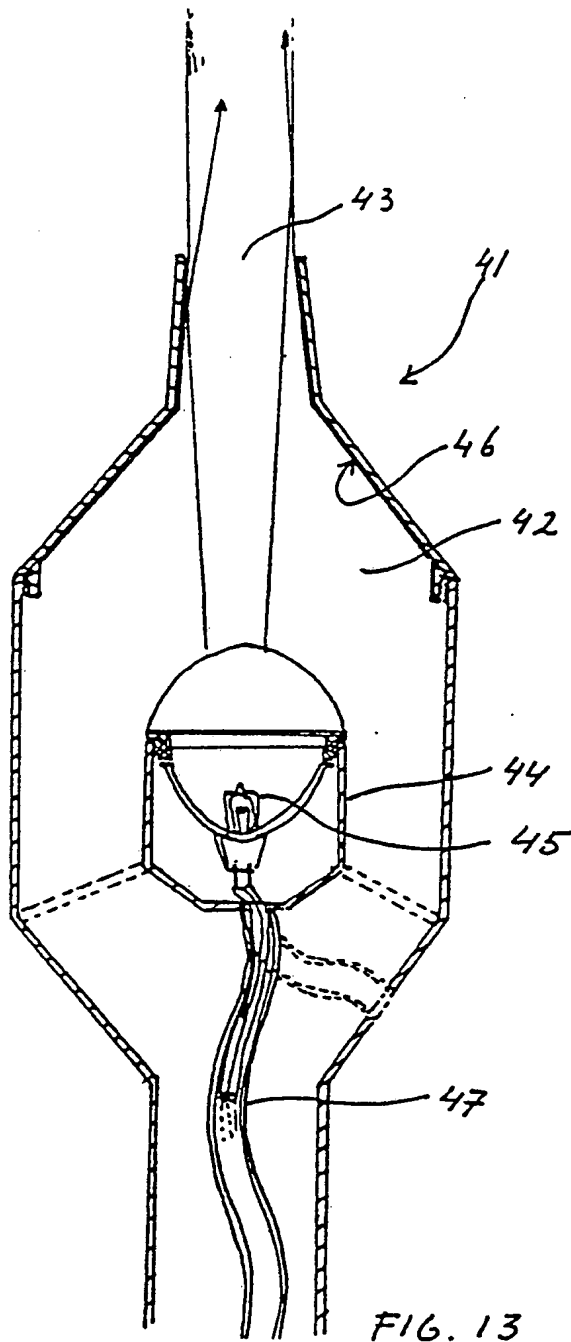


FIG. 12b

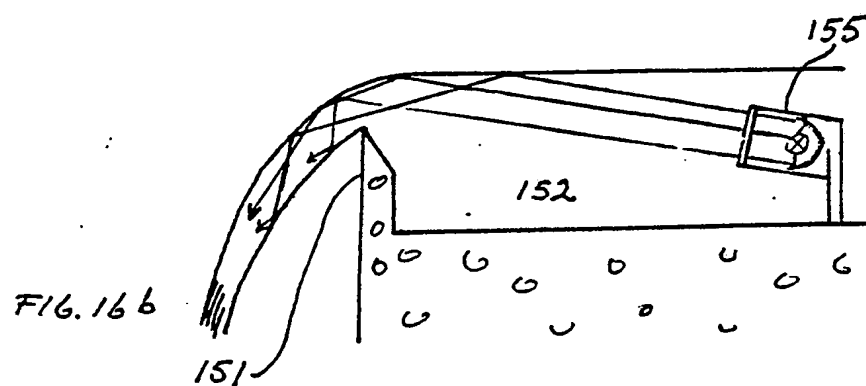
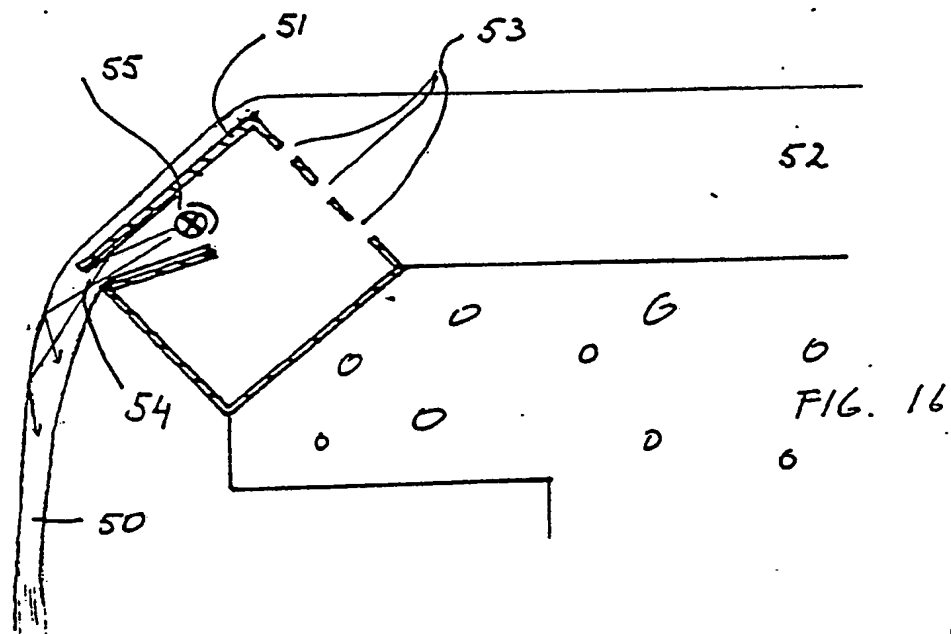
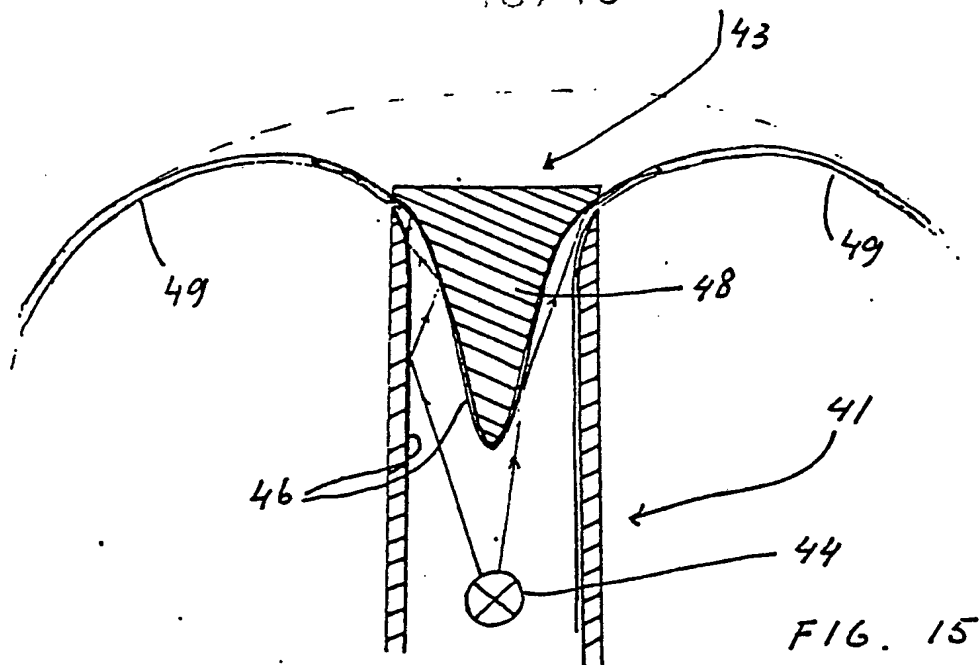
17/16



12/16



13/16



14 / 16

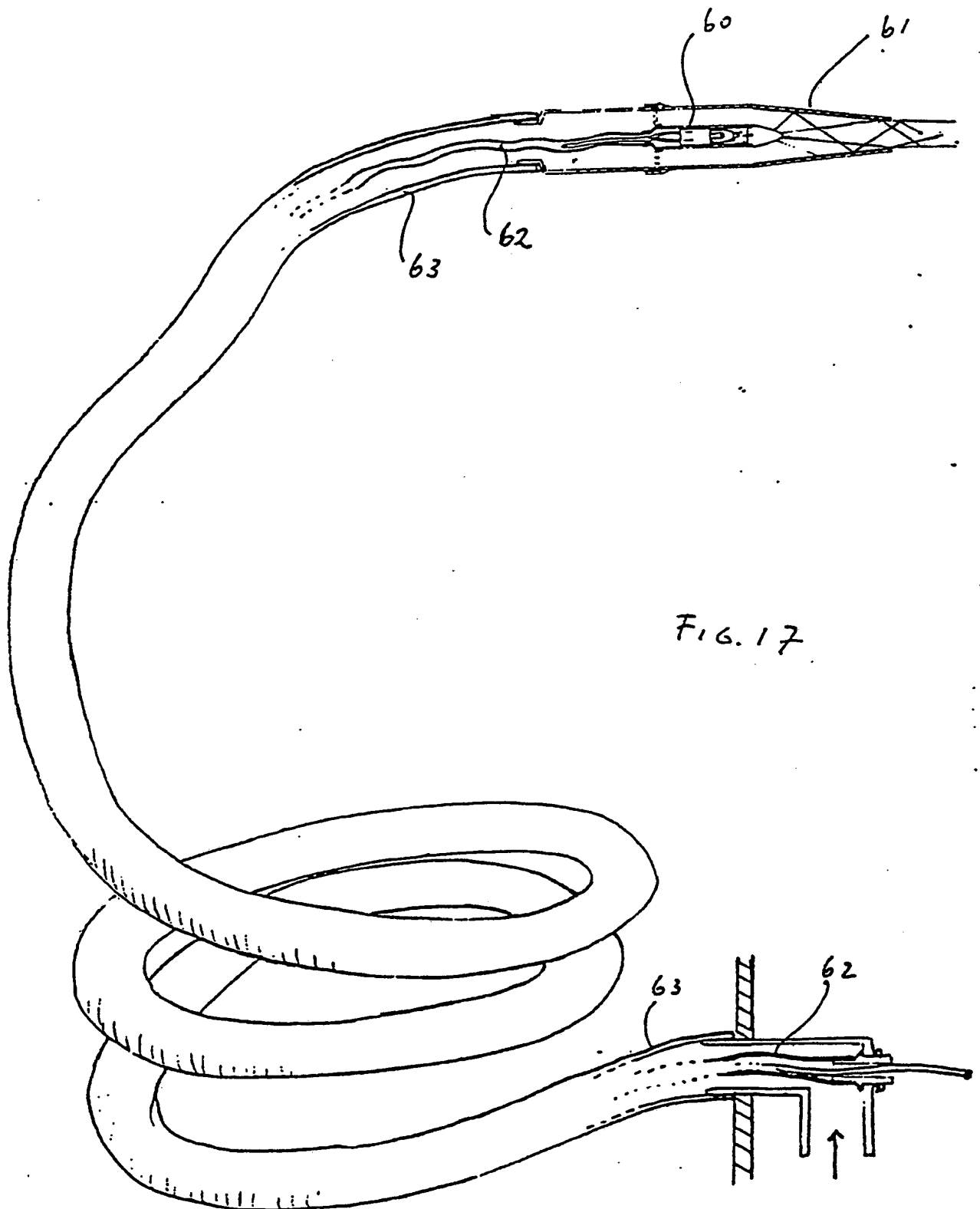
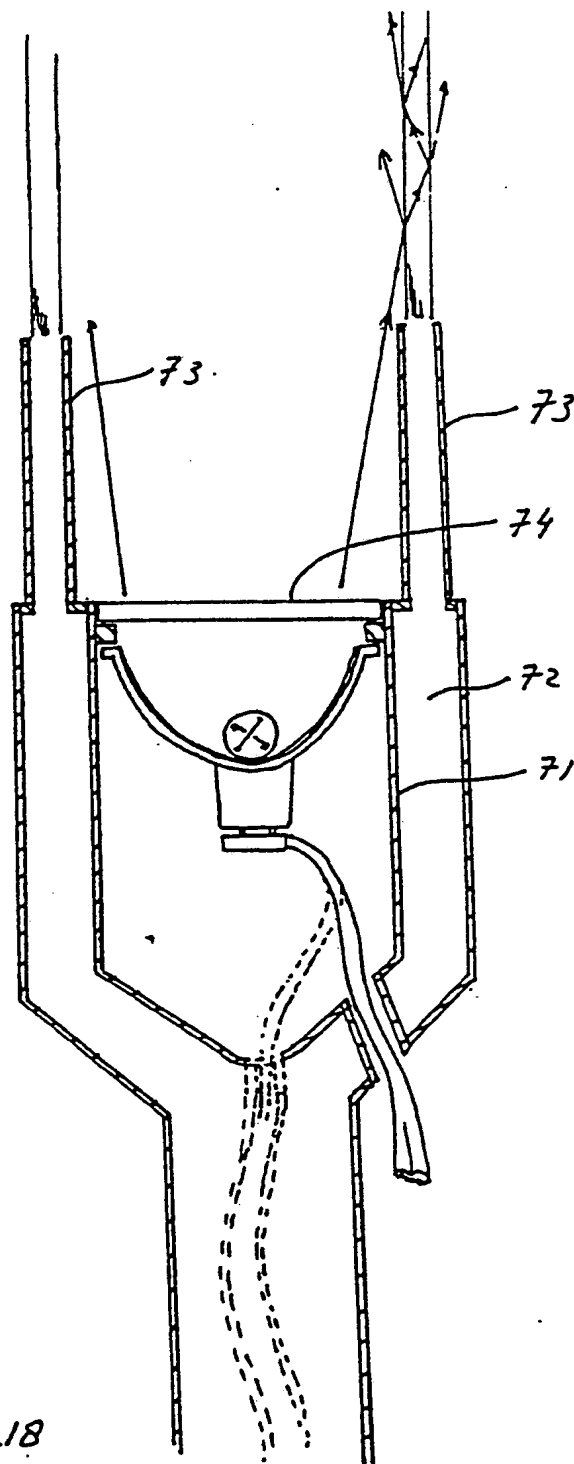


FIG. 17

15/16



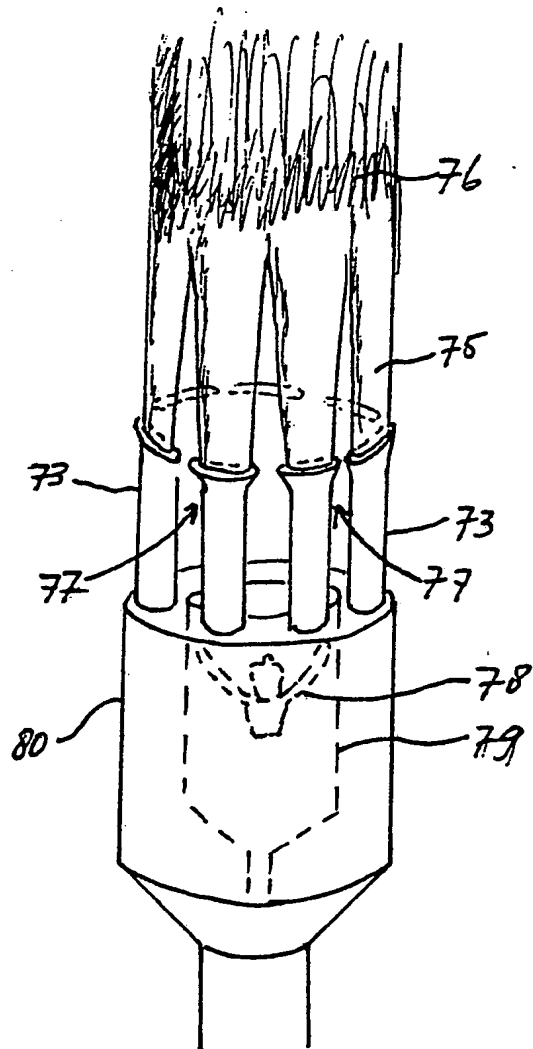


FIG. 18a



# INTERNATIONAL SEARCH REPORT

International Application No PCT/EP 85/00202

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC <sup>4</sup> : F 21 P 7/00		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
IPC <sup>4</sup>	F 21 P F 21 S B 05 B	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup></b>		
Category <sup>9</sup>	Citation of Document, <sup>11</sup> with Indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X	GB, A, 2099125 (HOBERN) 1 December 1982, see page 1, lines 94-98; figure 1	1,2,3,10,14, 17,23,30
	--	
X	FR, A, 1187689 (COMPAGNIE D'ELECTRICITE) 15 September 1959, see figures 1-6 (cited in the application)	1,3,4,6,8, 10,12,17,22
	--	
X	US, A, 3866832 (NOGUCHI) 18 February 1975, see column 3, lines 64-68; figures 1-6	1,3,13,14, 16,17,24,27
	--	
X	DE, C, 41825 (GUNTHER) 18 January 1890, see figures 1,3	1,3,12,14,27, 29
	--	
A	DE, A, 2427182 (GAREIS) 18 December 1975, see figure D	4,6,21
	--	
A	US, A, 1762383 (BOORAEM) 10 June 1930, see figures 9-39	4,6
	--	
A	FR, A, 593011 (GOSSELIN) 14 August 1925, see page 1, lines 48-54	25
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><sup>10</sup> Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p> </div> </div>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
6th August 1985	06 SEP. 1985	
International Searching Authority	Signature of Authorized Officer	
EUROPEAN PATENT OFFICE	G.L.M. Kruidenberg	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document; with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	FR, A, 719705 (SANDOZ) 9 February 1932, see page 1, lines 8-16 --	26
A	DE, C, 401724 (TEICHMÜLLER) 9 September 1924, see page 1, lines 64-74 --	34
A	FR, A, 1567059 (MILLIARD) 16 May 1969, see page 1, column 2, lines 10-18  -----	35

# ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO.

PCT/EP 85/00202 (SA 9502)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 28/08/85

The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A- 2099125	01/12/82	None	
FR-A- 1187689		None	
US-A- 3866832	18/02/75	FR-A,B 2255642	18/07/75
DE-C- 41825		None	
DE-A- 2427182	18/12/75	US-A- 4012630	15/03/77
US-A- 1762383		None	
FR-A- 593011		None	
FR-A- 719705		None	
DE-C- 401724		None	
FR-A- 1567059	16/05/69	None	

For more details about this annex :  
see Official Journal of the European Patent Office, No. 12/82